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ABSTRACT

Attitudes of middle grade science teachers toward use of hands-on science were examined through the use of a 12 question Likert scale survey. The population consisted of Georgia Southwestern College Graduate School Division of Education students attending the Fall Quarter, 1993. Subjects selected were teachers who had taught or were currently teaching science in grades four through eight. Twenty-one subjects (N=21) completed the survey. Analysis of results revealed: (1) all teachers supported the use of hands-on science instruction; (2) a majority of teachers believed they were adequately prepared by their undergraduate (57%) and inservice training (67%) to conduct hands-on science; (3) a majority of teachers (71%) consider their classrooms to be inadequately equipped to conduct hands-on science; and (4) the majority of teachers (86%) using hands-on science less than or equal to 25% of classroom instruction time reported their classrooms as poorly equipped for hands-on science instruction. Survey results suggest that investment in science laboratory facilities and easier procurement methods would increase the use of hands-on science instruction. Survey instrument included. (Contains 55 references.) (Author/LZ)

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Teacher Attitudes Toward Hands-on Science Instruction Versus Traditional Teaching Methods

George E. Collison

Georgia Southwestern College

Fall Quarter, 1993

ED 380 271

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Abstract

Attitudes of middle grades science teachers toward use of hands-on science were examined through the use of a 12 question Likert scale survey. The population consisted of Georgia Southwestern College Graduate School Division of Education students attending the Fall Quarter, 1993. Subjects selected were teachers who had taught or were currently teaching science in grades four through eight. Twenty-one subjects (N=21) completed the survey. Analysis of results revealed: (1) All teachers supported the use of hands-on science instruction. (2) A majority of teachers believed they were adequately prepared by their undergraduate (57%) and (3) inservice training (67%) to conduct hands-on science. (4) a majority of teachers (71%) consider their classrooms to be inadequately equipped to conduct hands-on science. (5) The majority of teachers (86%) using hands-on science less than or equal to 25% of classroom instruction time reported their classrooms as poorly equipped for hands-on science instruction.

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Teacher Attitudes Towards Hands-on Science Instruction Versus Traditional Methods

Statement of the Problem

The purpose of this study was to examine attitudes of middle grades science teachers toward the use of hands-on instruction in their science classes. This study also examined teacher attitudes toward factors which might affect their ability to conduct hands-on science instruction such as equipment and supplies, and the teacher's own preparation.

Studies have shown that United States eighth graders consistently lag behind their foreign counterparts in science achievement (Ornstein and Levine, 1993). In order to overcome this situation, students must be taught utilizing the best instruction known to educators. Research has shown that the use of hands-on teaching in the science classroom improves a student's ability to comprehend material when compared to the use of the traditional "textbook only" approach (Meichtry, 1992a; Reynolds, 1991a, 1991b). In addition, students receiving hands-on instruction also demonstrate

an improved attitude toward science in general (Linn and Songer, 1993; Gardner, Simmons and Simpson, 1992; Howick, 1991; Powers, 1990). However, Mullis and Jenkins (1988) reported 30% of seventh grade students had never conducted an experiment. This percentage increased to just 50% over the next four years (Jones, Mullis, Raizen, and Weiss, 1992). If hands-on science increases student comprehension and improves student attitudes, the question remains as to why hands-on science instruction is not utilized more frequently?

Significance of the Study

While research has shown that hands-on science is an effective way of teaching, little to no research has been done on why teachers do not use this technique as often as they could. If the teaching of science is to be improved, reasons for the low use of hands-on techniques must be found and steps taken to correct them. This could lead to more effective teaching and ultimately higher achievement by science students.

Definition of Terms

1. Laboratory experience - In the literature this is often referred to as hands-on, inquiry based, experiential, or cooperative learning. students

individually or in groups, observe and/or manipulate physical processes or objects while recording data. Manipulation may be computer simulated or take place in an actual laboratory setting.

2. Traditional teaching method - The student is taught by means of lecture and recitation supplemented by audio-visual aids and the textbook.

3. Middle grades - A philosophy of education that provides a transition period for students between elementary and secondary levels of education. This period usually covers grade levels four through eight.

4. Self-contained classroom - A classroom in which the teacher instructs the same set of students throughout the day in one classroom. All grade level subjects are taught by the same teacher.

5. Science-only classroom - A classroom in which the teacher instructs rotating groups of students only grade level science throughout the day.

Limitations

1. The survey instrument was not validated.

2. The number of subjects sampled in the survey (N=21) and the method of their selection does not permit generalization to all middle grades science teachers.

Review of the literature

Rationale for the use of hands-on science. In a discussion of scientific literacy, Pearson (1990) defined science in part, "As a way of investigation or method, science is hands-on activity; an experiment that requires observation, measurement, hypotheses formulation, and the qualification of empirical observations." The optimal way for students to learn this aspect of science is experientially, rather than didactically.

Piaget (1972) found students in the middle grades age group were operating in the concrete and formal stages of development. Therefore, a large number of middle grades students may have difficulty dealing with abstract concepts presented in some middle grades science classes. Clement (1982) reported students often arrive
in the classroom with preconceived ideas about basic scientific concepts which he referred to as "conceptual primitives". Clement concluded that conceptual primitives are very hard for a teacher to overcome and often require hands-on experiences. Meichtry (1992a) studied students in grades six through eight and found

the use of hands-on science activities provided the concrete learning experiences students needed to better understand the concepts presented. Renner, Abraham, Grzybowski, and Marek (1990) studied eighth grade student comprehension of four physics concepts presented using textbook instruction. A majority of the students were operating at a concrete operational level and did not fully understand the concepts as presented in the textbook. The researchers hypothesized that supplementing the textbook with experiments would have increased comprehension. The work of Vasu and Howe (1989) with 22 fourth grade students demonstrated that students who had a piece of fruit described to them and who were then allowed to handle the fruit evidenced better recall then students who only had the fruit described to them. In a longitudinal study of seventh grade students, Reynolds (1991a) found that providing activity-based learning experiences was one means of enhancing classroom content. Additionally, science process skills were found to be positively influenced by the number of experiments fourth through eighth grade students completed although their knowledge base was not effected (Reynolds, 1991b).

Brunkhorst (1992) reported a positive correlation between exemplary middle grade science programs and the use of hands-on techniques. Teachers in exemplary programs used daily hands-on activities 91% of the total school days and lecture an average of only 21% of each class period. This compares with a national average of 18% and 36%, respectively. Additionally, daily hands-on activities were used 91% of the total school days compared to daily discussion which was used on an average of 35% of the class period. Nationally, discussion was used more frequently (54%) than hands-on (18%). Brunkhorst (1992) determined that students in the exemplary schools achieved a higher level of science knowledge and developed a more positive attitude towards science.

Utilization of hands-on science in the classroom. The literature suggests that hands-on science is not being used as often as it could be. Orpwood and Souque (1984) found that among Canadian educators, even though the various provincial ministries of education recommended science programs be activity based or use the inquiry approach, teachers continued to use textbooks as their primary teaching tool 75% of the

time. A survey of American schools (Mullis and Jenkins, 1988) found reading a textbook the most often used instructional activity reported among middle grades students. One half or more of surveyed students also denied conducting independent science experiments or going on field trips. In a follow-up study conducted in 1990, Jones, Mullis, Raizen, Weiss, and Weston (1992) found nearly half the teachers surveyed relied on textbooks. Thirty nine percent also felt they had inadequate facilities to teach laboratory science. Jones et al. (1992) in an attempt to determine the amount of hands-on instruction students were receiving, asked students about their use of common science equipment such as microscopes, telescopes and electrical meters. Only 15% of the fourth graders and 35% of the eighth graders reported having used this equipment in school or at home.

Student benefits of hands-on science instruction. A majority of the studies reported hands-on instruction was more effective in improving student learning and attitudes toward science then traditional teaching methods (Mattheis and Nakayama, 1988; Gardner, Simmons, and Simpson, 1992; Linn and Songer, 1991a, 1991b).

Hands-on instruction was also reported to be an effective means of integrating different school subjects (Hershey, 1991).

Mattheis and Nakayama (1988) integrated a laboratory-centered inquiry program into a sixth and seventh grade science curriculum. They concluded that a laboratory-centered inquiry program could enhance students total ability in science. May's (1992) field analysis of an Integrated Activity Learning Sequence (IALS) curriculum revealed that the curriculum resulted in significant academic gains for students. Howick (1991), in a case study of a marine science program entitled For Sea, reported students demonstrated a significant increase in knowledge about the marine environment.

Sunal (1991) reported a correlation between the availability of laboratory equipment in schools and higher test scores on the Comprehensive Test of Basic Skills (CTBS). Student use of laboratory activities also correlated to higher CTBS scores (Sunal, 1991). Gardner, et al. (1992) reported that hands on activities increased a student's knowledge of science as measured by pretest and posttest scores. However, when hands on

activities were combined with computer aided instruction (CAI), the increase in student knowledge was even greater. In the Computer-as-Lab-Partner (CLP) curriculum, Linn and Songer (1991a, 1991b) emphasized experiment-based instruction and computer simulation. Students not only gained knowledge but were better able to integrate that knowledge. Students demonstrated an understanding of graph interpretation, ability to evaluate computer generated data, understand experimentation, and distinguish between heat energy and temperature.

Hershey (1991) reported that one of the benefits of hands-on science was the integration of history and science through the replication of classic biology experiments.

In contrast to studies by Mattheis and Nakayama (1988), Gardner, et al. (1992), and Linn and Songer (1991a, 1991b); Sheng (1991) found no significant difference in test scores of Taiwanese classes that used cooperative learning. McPartland and Wu (1988) reported a strong but quite small relationship between science experiments and science test performance.

Hands-on science and student attitudes. Gardner,

et al. (1992) reported use of hands-on activities improved student attitudes towards science. These changes were enhanced by the addition of CAI.

Linn and Songer (1991a) reported only 20 percent of the students they studied thought of science as ideas to be understood and relevant to their lives. Twenty percent thought science was a collection of ideas to be memorized but not relevant to their life. The remaining 60% had a mixed view of science. Linn and Songer's use of experiments and computer simulations in the CLP curriculum allowed students to integrate knowledge gained and relate it to their world. Linn and Songer (1993) reported students using the curriculum were more task oriented, enthusiastic and enjoyed science. They also demonstrated an increasing ability in applying science to everyday life. Howick (1991) reported students experienced an enhanced positive attitude toward marine concepts upon completion of the For Sea program. Powers (1990) reported students preferred using hands-on instruction in the classroom. The students indicated that they learned more science by doing science and exhibited a better attitude towards science.

Student activities and curriculum. Kepler (1992a, 1992b) described science activities for fourth through sixth grade that included classification of plants and animals, and a demonstration of bat echolation. Gore and Gregg (1992) described three demonstrations that can be used to illustrate static electricity. Robinson, Schaffer, and Shimonauff (1989) developed a space science curriculum for gifted sixth graders. Students learn about space by simulating a voyage into space. They design the spacecraft, determine the makeup of the crew and plan the mission. Finally, the students conduct the flight in the classroom.

Norton, Reisdorf, and Spees (1990) described a program where student homes become an extension of the classroom. This program entitled Science: Parents and Children Explore (SPACE) utilizes the premise that students doing science at home will come to see science as a normal part of their lives. An additional benefit was the involvement of parents in their child's education.

Meichtry (1992b) evaluated a curriculum developed by the Biological Science Curriculum Study (BSCS) entitled Science and Technology: Investigating Human

Diversity. This curriculum allows students to explore ideas through the use of hands-on activities. Meichtry reported student understanding of the developmental and testable nature of science decreased in the group using the BSCS curriculum. While Meichtry acknowledges the need for a curriculum like the BSCS curriculum, more studies of a longer duration are needed to fully understand the effectiveness of this curriculum.

Professors Pine and Bower (cited in Watkins, 1992) of the California Institute of Technology, developed Project SEED, Science for Early Elementary Development, a curriculum involving 28 experiment based, hands-on modules covering various aspects of science. Students learned science by completing the modules. This program was found to be particularly useful for students who possessed poor language arts skills and has since been adopted as the official elementary science curriculum for the Pasadena school system. Barman and Kotar (1989) and Fields (1989) describe the use of the scientific method to introduce concepts to students. They are given a kit of materials and asked to solve a problem. Problems range from lighting a bulb given wire, batteries and a light bulb, to determining aerodynamic

principles by building and flying paper airplanes. By solving the problems, the students are introduced to basic scientific concepts which are then explored in more detail. Blueford (1989) describes a science curriculum developed by the United States Geological Survey entitled Science Mate, a 34 week program that uses science activities as the main teaching tool. Teachers using this curriculum found students were more engaged in the classroom and showed a greater interest in science.

Computer simulation of laboratory experiences. Linn and Songer (1991a,1991b,1993), and Litchfield and Mattson (1989) developed separate science curricula utilizing computer simulation. Linn and Songer's CLP curriculum used computer software while Litchfield and Mattson used a student controlled, computerized, videodisc system to simulate various interactive and real time experiments. Researchers reported students found learning more interesting and engaging when working with these systems. They also demonstrated a better understanding of the principles taught.

Use of outside resources for hands-on experiences. Harte (1989) reported that previous studies have shown

25% of students were discouraged and bored because most science classrooms lack a stimulating environment. Science centers offer an opportunity for children to experience a stimulating environment. However, Harte (1989) feels outside resources are often misused by schools. Class trips to these facilities are usually seen as a social event rather than as an educational experience. Harte (1989) believes that schools need to reorder their priorities and use these outside resources as an educational extension of the classroom. Many colleges, universities and museums have developed programs to provide hands-on experience for students.

Elias (1992) designed a program to bring hands-on science into the local schools where he conducts various science experiments for students demonstrating basic scientific principles. Students are allowed to participate and they leave his demonstrations with a renewed interest in science and a better understanding of how science is done. Beane (1990) describes a program developed by the National Urban Council (NUC) to promote science and mathematics in urban, predominantly African-American schools. This program utilizes after-school activities to involve students in science and

math through the use of hands-on activities and demonstrations. Beane (1990) reported an increase in science test scores and positive student attitudes towards science. A positive effect on student self-esteem was noted as well. Foley (1989) of the Boston Museum of Science describes a program the museum coordinates entitled Science By Mail. This is an enrichment activity designed for students in grades four through nine. Three times a year, the museum sends students from around the world a problem solving activity packet through the mail. The children develop their own solutions to the problems and send them back to the museum. The museum then sends the solutions to 350 scientist pen-pals who write to the children and discuss their solutions. Once a year, all the participating students and scientists get together at the museum and participate in activities. This program has been expanded to include other museums and institutions from around the country.

Seidman (1989) described the Math and Science Enrichment Center in East Cleveland, Ohio. This center is located in a library and provides hands-on experiential learning for students and inservice

training for teachers. The center also operates after-school and serves as a science resource for children and their families. An increase in the use of hands-on science lesson plans has been observed by local curriculum specialists.

Problems in the use of hands-on science. Several problems in the use of hands-on science in the classroom were addressed in the literature. These include lack of facilities, poor textbook activities, and student safety issues.

Mullis and Jenkins (1988) reported only 66% of seventh grade science teachers had access to a science teaching laboratory of any kind. Pizzini, Shepardson, and Abell (1991) investigated the inquiry level of activities in current junior high science textbooks. Pizzini, et al. (1991) found these activities to be very structured and not readily adaptable to different student learning styles. They determined that the need for open-inquiry activites was not being met by today's textbooks, and teachers have the responsibility for providing this level of activity for their students.

Gerlovich and Gerard (1989) addressed student safety and school liability. Several court rulings have

established that schools have three basic responsibilities regarding hands-on science and their students. The first is that all students must be informed of the dangers they might encounter in the classroom. Second, the school must provide a safe learning environment. Third, the school must provide adequate supervision of students. Failure to adequately comply with any of these three requirements could lead to student injury and/or legal action against the school.

Knight (1989) reported students did not always see hands-on experiences as a serious educational opportunity, but as a time to "fool around" with the equipment. Additionally, when an experiment did not work, students often treated it as if it did not exist, rather than use it as a learning opportunity and investigate why the failure occurred. Knight (1989) argues that teachers need to work with their students and change these attitudes.

Assessment of hands-on learning. Several researchers addressed the issue of how to assess hands-on learning. Baxter, Shavelson, Goldman, and Pine (1992) felt that the best way to find out what students

knew about science was to watch them do science. Their study looked at three different ways of grading hands-on experiments. The subjects of this study were 96 fifth grade students. The group consisted of 41 students experienced in and 55 students not experienced in hands-on instruction. Trained observers watched and graded students as they performed experiments. The students then described their experimental procedure and it's results in a notebook. These notebooks were read and graded by an independent grader. The researchers then combined the two systems and compared it against the use of the two separately. Finally, the researchers administered a multiple choice test to the students and compared all the different methods of assessment.

Researchers found the most reliable grading system to be the observer method (.92)and the least reliable system to be the notebook method (.66). When the two grading systems were combined together, the reliability was somewhere between the two (>80). The correlation between the multiple choice test and the other methods of assessment was low (.46). Baxter et al. reported that this low correlation possibly could have indicated that different aspects of science achievement were

measured by multiple choice tests when compared to hands-on assessment. Researchers determined that hands-on science activities could be reliably scored and that a grading system could be developed. Shavelson and Baxter (1992) found creating performance assessments to be time consuming and required significant scientific and technical knowledge. Baxter (1992) reported when assessment testing was introduced, it tended to be a list of instructions rather than explorations of science. Additionally, teachers began to teach to the "test" and the aspect of students doing science was lost.

Isenberg (1989) and Cheek (1992) described the Elementary Science Progress Evaluation Test (ESPET) developed by the state of New York and administered to fourth grade students. ESPET was designed to measure student abilities at observation, classification, communication, measuring, data collection, predicting, hypothesizing and generalizing. It consists of five timed science experiments set up for the students to perform. Cheek (1992) reported that this type of testing is now being used by the states of California, Connecticut and Kentucky as well as Great Britain.

Teacher preparation for hands-on science. In order for teachers to be adequately prepared to teach science, not to mention hands-on science, they should be exposed to science in either their undergraduate studies or employment in private industry. Orpwood and Alam (1984) looked at the educational background of science teachers in Canada. They found that over one-third of all the middle grades teachers surveyed had not taken any university level mathematics or science courses as part of their undergraduate degree program. Almost one third of the teachers had never taken a mathematics or science course since starting their teaching careers and another one-third of the teachers surveyed reported not having taken a course within the previous ten years. Taking into account that teachers could learn science through science related employment, Orpwood and Alam (1984) also looked at this factor but discovered that almost half of the teachers surveyed reported that they had no prior science related employment experience.

Teacher certification in the science field is usually taken as an indicator of proficiency. Mullis and Jenkins (1988) reported although 63% of the middle grades teachers held a science certification, 95%

believed they were prepared to teach science. By 1990, Jones et al. (1992) found that the percentage of science certified teachers had risen from 63% to 76%.

Estes (1990) reports that most people now teaching elementary science did not study physical science in college and that many did not study it in high school as well. There are occasional inservice programs which attempt to compensate for this or similar deficiencies in teacher training. For instance, Estes (1990) describes a summer science program developed by the Science Education Center at the University of Texas, Austin. The purpose of this program is to give practicing teachers the content and skills necessary to teach science. Teachers are taught the basic concepts of science and practiced hands-on activities for use in their classrooms. They then write a science curriculum which is field tested during a summer science camp for students in kindergarten through fifth grades. After the summer camp, teachers revised their curriculum based on their experiences and used that curriculum during the following school year.

Daugs and Emery (1989) reported on an elementary science methods course taught at Utah State University.

This course pairs prospective science teachers with research scientists. They work with the scientists on actual research problems for 20 hours. Teachers reported increased confidence in setting up science experiments for their students.

Hands-on science and the exceptional student. Tripp (1991) reported that hearing impaired children frequently enter classrooms as concrete learners. Tripp (1991) applied the scientific method to the classroom through the use of hands-on activities and found that these exceptional students developed many skills they would not otherwise have learned. These skills included observation skills, creative skills for problem solving, manipulative skills through the handling of equipment, and safety skills learned in the laboratory.

Allen (cited in Shymansky, 1978) found that disruptive students, contrary to expectations, engaged in hands-on activities and spent 90% of their time on task. Spellman (1989) building on the work of Allen, also used hands-on science learning with disruptive students. Contrary to the popular opinion expressed by her fellow teachers, Spellman (1989) also found disruptive students were able to stay on-task and

benefit from the use of hands-on science instruction.

Summary of the review of literature. A majority of the resources reviewed found that teaching science through the use of hands-on techniques resulted in positive benefits for students. Hands-on science activities contributed to better overall understanding of science by students and improvement in attitudes toward science in general.

Researchers who looked at the utilization of hands-on science in the classroom reported it was generally not used as often as it could have been. Teachers continue to rely heavily on textbooks as their primary teaching tool. However, several outside agencies have developed programs to augment the classroom as a source of hands-on activities. These programs are usually brought into the school or are available to the teacher as a source for field trips. In addition, some of these programs are made available to students after school or during summer vacation.

Computer software technology has advanced to the point that computerized laboratory simulations are now being used in some classrooms. Students run real time experiments through simulation and collect data for

analysis. The use of the computer in the classroom has been found to be an effective tool for teaching students basic science concepts and just as effective as actual laboratory activities at retaining student interest.

There were several articles concerning hands-on activites and exceptional children. Even though teachers at first questioned the ability of these students to remain on-task long enough to benefit, hands-on activities were found to be a positive experience for those exceptional students who were physically able to participate in them.

Study Questions

There were four questions guiding this study. They were:

1. Do teachers support the use of hands on science in the classroom?

2. Do teachers feel adequately prepared by their respective colleges and universities to implement hands-on science instruction in the classroom?

3. Do teachers feel inservice training adequately prepares them to use hands-on science in the classroom?

4. Do teachers feel their classrooms are adequately equipped to provide hands-on science

instruction?

Method of study

Subjects And Sampling

Subjects for this study were selected from the population of most graduate students attending Georgia Southwestern College, Division of Education during the Fall 1993 quarter. All subjects who have taught, or are now teaching science in the fourth through eighth grade were requested to complete the survey. There were twenty-one completed surveys (N=21). All teachers meeting the selection criteria completed the survey.

Instrument

A nonvalidated, researcher-developed instrument was used. The instrument consisted of 12 Likert type questions (see appendix A). Self-reporting research was selected because it was a more efficient and less time consuming way of collecting the data required to answer the four questions presented at the beginning of this study.

Experimental Design

The design of this study utilized a descriptive, qualitative Likert type scale survey (Gay, 1992). A five point scale labeled A through E was used. The

first three questions were demographic in nature and asked teachers what grade they taught, how many years experience they had, and whether they taught in self-contained or science only classes. Questions four and five explored teacher support of hands-on science. Questions six and seven examined teacher preperation. Questions eight, nine and ten dealt with the use of hands-on science in the classroom. Finally, questions eleven and twelve looked at hands-on teaching facilities and supplies.

Procedures

All subjects identified as meeting the criteria for inclusion in the survey were presented with a questionnaire and a Scantron form 882 to mark their answers on. The answers were tabulated on a Model 888P Scantron machine using the Tabulating Survey Results procedure outlined on page nine of the operating manual.

This tabulation method was selected for its accuracy, speed of tabulation and ease of use over other methods of tabulating data. In addition, subjects were already familiar with the proper use of the Scantron form 882 through their past use of this form in the taking of examinations. This reduced the risk of

marking error by the subjects completing the survey.

Results

Demographic Data

Questions one, two and three asked teachers what grades they taught, years of teaching experience, and whether they taught in a self-contained, or science only classroom.

Fifty two percent taught fourth grade, 24% fifth grade, none sixth grade, 19% seventh grade, and 5% eighth grade. Reported experience levels were 57% five years or less, 24% five to ten years, 10% ten to fifteen years, 10% fifteen to twenty years. No teachers had greater then twenty years of experience. Sixty seven percent reported teaching in self-contained classrooms and 33% science only.

Teacher Support Of Hands-on Science Instruction

Questions four and five asked teachers how highly they supported hands-on instruction and if they use it in their classrooms. All teachers supported hands-on science instruction to some extent with 77% reporting strong to enthusiastic support of hands-on science. Ninety five percent reported using hands-on science in varying degrees in the classroom.

Teacher Preparation To Conduct Hands-on Science Instruction

Questions six and seven asked teachers about their preparation to conduct hands-on science in the classroom. Question six asked if they felt that their undergraduate program adequately prepared them to teach hands-on science. Fifty seven percent believed they were adequately to very well prepared by their undergraduate programs, while 43% believed they were not. Question seven asked if inservice training helped prepare them to conduct hands-on science instruction. Sixty seven percent believed the training they had received adequately to very well prepared them for hands-on science, while 33% believed it had not.

The Effect Of Hands-on Science On Students

Question eight asked teachers if they felt that hands-on science instruction contributed to better student understanding of basic scientific concepts. All of the teachers surveyed felt that it did with 71% reporting that it strongly helped their students.

Class Time And Hands-on Science

Questions nine and ten asked teachers what percentage of their classroom time was spent doing

hands-on science. Nineteen percent reported using hands-on activities for 50% or more of their class time while 48% said they used hands-on science 25-50% of the time. Thirty one percent reported using hands-on science less then 25% of the time. None of the teachers reported not using hands-on science activities at all. Question ten asked if the amount of time spent on conducting hands-on science was sufficient. Sixty seven percent reported they did not spend enough time while 38% felt that the right amount or slightly too much time was spent doing hands-on science.

The Adequacy Of Classroom Facilities

Questions eleven and twelve asked teachers how well equipped they perceived their classrooms were to conduct hands-on science and how difficult it was for them to obtain supplies.

Only 29% of the teachers believed their classrooms were adequate to very well equipped. Thirty eight percent reported that their classrooms were less then adequately equipped and 33% said they were not equipped at all. Eighty six percent reported it was some what to very difficult for them to get supplies.

Experience And Support Of Hands-on Science Instruction

Post data collection review of the data raised several questions. One question concerned the experience level of teachers and their support for hands-on science. All of the teachers reported support for hands-on science to some degree. However, the level of support varied directly with the experience level of the teachers. Teachers with the highest levels of experience (10-15 and 15-20 years) were also the greatest supporters (100% enthusiastically supported). Sixty percent of teachers reporting 5-10 years experience enthusiastically supported hands-on while 58% of the teachers with 0-5 years experience also reported they were enthusiastically supportive. There were no teachers with greater then twenty years of experience.

Teacher Preparation

The next question raised was how well prepared teachers believed they were to use hands-on science. This question was first examined from the aspect of the type of classroom the teachers taught (self-contained versus science only). Self-contained teachers as a group believed their undergraduate program (50%), and

inservice training (65%) prepared them to use hands-on science. Science only teachers felt strongly (72% in both cases) that their undergraduate program and inservice training prepared them to teach hands-on science.

The data was then analyzed to compare grade level and teacher preparation. The data revealed that more lower middle grade (fourth and fifth) teachers (63%) believed they were prepared by their undergraduate programs then upper middle grade (seventh and eighth) teachers (40%). This trend was reversed for inservice training where more upper middle grades teachers (80%) then lower middle grades teachers (62%) believed their inservice training prepared them to teach hands-on science.

The question of teacher preparation was finally analyzed from the standpoint of hands-on usage. Analysis of the use of hands-on instruction compared teachers reporting high usage (more then 50% of classroom time) with teachers reporting low usage (classroom time of 25% or less). The high usage group felt more strongly (75%) then the low usage group (57%) that their undergraduate program prepared them to use

hands-on. However, both groups were evenly split on the question of inservice training. Fifty eight percent of the low usage group and 50% of the high usage group reported inservice training prepared them to use hands-on instruction.

Use Of Hands-on Instruction And Classroom Equipment

The final question raised by the data regarded usage of hands-on science and the availability of equipment to support such instruction. Once again, the data was analyzed to compare the high usage group with the low usage group. The survey revealed that 75% of high usage teachers believed their classrooms were equipped to conduct hands-on science instruction. In contrast, only 14% of the low usage teachers believed their classrooms were equipped to conduct hands-on science instruction. When asked how hard they felt it was to obtain supplies, 75% of the high usage group and 86% of the low usage group reported it was some what to very difficult.

Discussion

This research study was undertaken to determine the attitudes of middle grades science teachers toward the use of hands-on science in the classroom. The

study also investigated teachers perceptions of the leveladequacy of preparation by their undergraduate programs and/or current inservice training to conduct hands-on science in their classrooms. Teacher attitudes toward student benefits of hands-on instruction were also explored. Finally, the survey looked at how well equipped teachers thought their classrooms were for hands-on science and how difficult it was for them to obtain the necessary materials.

The population for this survey was restricted to students attending the Georgia Southwestern College Graduate School Division of Education. This imposed some limitations on the study due to the small population from which subjects were drawn. Additionally, restricting the population to graduate students only may have skewed the survey outcome, since students motivated to continue their education beyond initial certification requirements may have more exposure to hands-on methods than teachers not currently attending school. Intuitively one would predict that increased exposure results in teachers being more likely to support and use hands-on over traditional methods of teaching science.

Four questions were originally asked regarding teacher attitudes:

1. Do Teachers Support The Use Of Hands-on Science In The Classroom? The survey indicated that all teachers who were queried supported the use of hands-on science instruction to some degree. Sixty seven percent did so enthusiastically. This result could be attributed to the subjects being graduate students with possibly more familiarity with methodologies addressed in the current professional literature.

Further analysis of the data revealed support for hands-on science varied according to how much experience the teachers had. Generally, the more experience teachers had, the more they supported hands-on instruction. Teachers reporting the most experience (15-20 years) were the strongest supporters with 100% reporting enthusiastic support of hands-on science. In contrast, those teachers with the least experience (0-5 years) reported the least support for hands-on science with only 58% of this group reporting enthusiastic support. However, it should be noted that the most experienced teachers comprised the smallest group (2 out of 21) and that the least experienced teachers made up

the largest group (12 out of 21) of teachers that were surveyed.

Data from this study revealed teachers do support hands-on instruction.

2. Do Teachers Believe They Are Adequately Prepared By Their Respective Colleges And Universities To Implement Hands-on Science Instruction In The Classroom? Overall, a majority (57%) of the teachers queried believe they were adequately prepared to use hands-on science in the classroom. These results appear to support previously published work (Orpwood and Alam, 1984; Mullis and Jenkins, 1988; and Jones et al., 1992). Orpwood and Alam (1984) reported that 66.5% of Canadian middle grades teachers believed the science education they received was satisfactory for them to teach science. When asked about their teacher education, 68.2% believed it was also satisfactory. Even though they did not ask teachers about the instructional method used in their classrooms, Mullis and Jenkins (1988) reported that 95% of the seventh grade teachers they surveyed felt prepared to teach science.

The data was further analyzed to evaluate; the effect of classroom type (self-contained versus science

only), grade level taught (fifth and sixth grade versus seventh and eighth), and the frequency of use of hands-on (> 50% versus < 25% of class time), with how well prepared teachers felt they were to use this technique.

In all cases except for upper middle grade and self contained teachers, a majority reported adequate preparation to conduct hands-on science.

Data from this study revealed teachers did feel adequately prepared to use hands-on instruction.

3. Do Teachers Believe Inservice Training Adequately Prepares Them To Use Hands-on Science In The Classroom?

All teachers undergo inservice training to keep current in the latest teaching techniques and theories. Teachers were asked if they believe the quality of the inservice training they were receiving adequately prepared them to use hands-on science in their classrooms. This question was analyzed from an overall viewpoint as well as class type taught (self-contained and science only) and degree of hands-on usage (less than or equal to 25% and greater than 50%). With the exception of those teachers who used hands-on techniques more then 50% of their class time, teachers in all categories believe their inservice training did

adequately prepare them to use hands-on science. The exception to this finding were teachers reporting use of this technique greater then 50% of the time. Of that group, 50% believe they were adequately prepared.

This question was not addressed by previous studies (Orpwood and Alam, 1984; Mullis and Jenkins, 1988; and Jones, et al., 1992). However, data from this study revealed teachers did believe they were adequately prepared by inservice training to use hands-on techniques.

4. Do Teachers Believe Their Classrooms Are Adequately Equipped To Provide Hands-on Science Instruction? This question was analyzed from an overall viewpoint, and the viewpoint of those teachers reporting little use (less then or equal to 25%) of hands-on science. In both instances, teachers reported they believed their classrooms were not adequately equipped for them to use hands-on science techniques (71% overall and 86% of the low users). As a follow-up question, teachers were asked how hard it was for them to obtain supplies. Once again, a majority (86% in both cases) believed they experienced difficulty obtaining supplies.

The results of this survey contradict results of

previous surveys (Orpwood and Alam, 1984; Mullis and Jenkins, 1988; and Jones et al., 1992). Orpwood and Alam (1984), reported 75.2% of the teachers surveyed had access to a hands-on science facility. While Mullis and Jenkins (1988) did not ask this question directly, they reported 66% of seventh grade teachers had access to a science teaching laboratory. In a 1990 follow-up study, Jones et al. (1992) reported 56% of eighth grade teachers felt their facilities for teaching laboratory science were adequate. Additionally, 56% felt they were well supplied with science instructional materials.

Data from this study revealed teachers do have difficulty in obtaining supplies for hands-on science.

Recommendations

Even though research has shown hands-on science to be a very effective method of teaching, this survey revealed that a significant percentage of teachers still do not use hands-on science in the classroom as often as they could and as often as even the respondents believe they should. This survey tried to find reasons for this. It appears that while teachers believe they are adequately prepared to use hands-on science, they also often perceive their classrooms as not prepared for

proper hands-on instruction. The data appears to indicate that if school systems could invest more time, money, and effort into improving science laboratory facilities and make procurement of supplies easier, teachers may be more prone to use hands-on science instruction when teaching their students.

Due to the limitations of this study, it is recommended that any future study broaden the population base beyond the area serviced by Georgia Southwestern College and include practicing teachers who are not currently enrolled in school. Additionally, subjects for this survey were primarily drawn from a rural area so teachers from large urban areas were not represented. Since a significant number of students today are serviced by large urban school systems, it is also recommended that future studies include teachers from urban school systems.

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Appendix A

Middle Grades Science Teacher Questionnaire

Do not mark on this questionnaire
Mark all answers on the scantron sheet provided
No names please
Thank you for your cooperation

1. What grade do you teach? (Choose only one)

4th	5th	6th	7th	8th
A	B	C	D	E

2. How many years of experience do you have as a teacher?

20-25	15-20	10-15	5-10	0-5
A	B	C	D	E

3. Do you teach science in addition to other subjects (self-contained) or do you teach only science?

   (A) Self-contained (B) Science only

4. Do you support the use of hands-on science as a method of instruction in the classroom?

Enthusiastically Support		Support		Do not Support
A	B	C	D	E

5. Do you conduct hands-on science instruction in your classroom?

   (A) Yes (B) No

6. Do you feel that your particular teacher preperation program adequately prepared you to conduct hands-on science instruction?

Very Well Prepared		Adequately Prepared		Not Adequately Prepared
A	B	C	D	E

7. Do you feel that your science inservice training prepares you to conduct hands-on science instruction?

Very Well Prepares		Adequately Prepares		Does Not Adequately Prepare
A	B	C	D	E

8. Does the use of hands-on science in your classroom help your students understand scientific concepts better?

Strongly helps		Moderately helps		Does Not help
A	B	C	D	E

9. What percentage of your classroom time is spent conducting hands-on science?

75-100	50-75	25-50	1-25	0
A	B	C	D	E

10. How do you feel about the amount of classroom time devoted to hands-on science?

Not Enough		Right Amount		Too Much
A	B	C	D	E

11. How well equipped is your classroom for conducting hands-on science?

Very Well		Adequately		Not at all
A	B	C	D	E

12. How difficult is it for you to obtain the supplies you need to conduct hands-on science?

Very		Some what		Not at all
A	B	C	D	E